XII.—*Observations on Raphides and other Crystals in Plants.*

By George Gulliver, F.R.S.

[Continued from vol. xv. p. 458.]

The object of this paper being to show how the order Vitaceæ differs, in the possession of the character of raphis-bearing, from its allies, they will here follow as enumerated by Prof. Lindley.

Droseraceæ.—Dried specimens of *Drosera rotundifolia* and *D. anglica*: no raphides.

Fumariaceæ.—Of these were examined fresh plants of *Fumaria officinalis* and another English species, *Dielytra spectabilis*, and *Corydalis*, sp., in none of which could raphides be detected.

Berberidaceæ.—Leaves and fruit of *Berberis vulgaris*, *B. Japonica*, *B. Darwinii*, *B. dulcis*, *B. aquifolia*, and leaves and ovaries of *Epimedium alpinum*, *E. macranthum*: no raphides in any of them; a few sphæraphides in the fruit of *Berberis vulgaris*.

Vitaceæ.—Raphides and other crystals in the Grape-vine have been long known (Edwin Quekett, Lindley's 'Introduction to Botany'); and I have already indicated that the character may pervade the whole order ('Annals,' Dec. 1863 and Jan. 1865). Lately I have repeated my former observations, and extended them to more species of this order and its allies. The Vitaceæ examined are *Cissus discolor*, *Vitis vinifera*, *V. odoratissima*, *V. apiifolia*, *Ampelopsis hederacea* and two other species, and two species of *Leea*. Every one of these plants afforded raphides and sphæraphides in more or less abundance. The *Leeæ*, though merely old dried fragments of leaves and flowers, exhibited the raphides and sphæraphides in abundance, the raphides often in bundles, and still more frequently swimming separately in the water on the object-plate. All the other Vitaceæ were fresh and healthy plants. In *Cissus*, the sprigs, tendrils, young leaves, and stipules all abound in raphides, some within short oval-shaped cells; there were also other cells, longer, much tougher, and narrower than the former, pointed or nipple-shaped at the ends, and containing raphis-like objects. Whether these be true raphides requires further examination to determine; for they are very fine and fragile, and (unlike the obvious raphides of this plant) difficult to separate from each other and from their cells. They are common, with the regular raphidian cells, in the leaves, and especially plentiful in the thick base of the stipules.

Pittosporaceæ.—Fresh leaves and twigs of *Pittosporum undulatum* and *P. tobira*: some sphæraphides in the leaves and mesophlœum, but no raphides. Dried fragments of leaves and flowers of *Bursaria spinosa*, *Marianthus candidus*, *M.* sp., and *Cheiranthera linearis*: a few sphæraphides in each of these plants, but no raphides. Fresh leaves of *Sollya heterophylla*: no raphides,

but many sphæraphides. In short, these Pittosporaceæ afford sphæraphides, but are quite devoid of raphides.

Olacaceæ.—Dried leaves of *Olax scandens, O. stricta, Lirosma,* sp., *Heisteria cyanocarpa, Ximenia americana, Icacina senegalensis, Aphodytes,* sp., *Gomphandra axillaris, Pogopetalum aculeatum,* and *Cansjera scandens*: all these Olacaceæ and Icacinaceæ devoid of raphides.

Araliaceæ and *Rhamnaceæ.*—Of these orders the following plants were examined, and none of them afforded any raphides: *Aralia leptophylla, A. nudicaulis, Hedera Helix, Rhamnus Alaternus, Ceanothus azureus,* and *C. divaricatus.* Some of them abound in sphæraphides, as may be well seen in *Aralia* ('Annals,' April 1864) and *Rhamnus.* In the last plant they form a beautiful sphæraphid tissue, of which there is a plate from *Lythrum* in the 'Annals' for September 1863, pl. IV. fig. 13. This tissue occurs in the leaves, liber, and between the medullary rays and alburnum of *Rhamnus.*

On the present occasion negative results of searches for raphides are detailed more particularly than has been usual in these papers, in order that botanists may estimate the observations on Vitaceæ at their true value, and more especially as Mr. W. H. Baxter has kindly afforded me the means of making comparative examinations of all the above-named Leeæ, Pittosporaceæ, and Olacaceæ.

Excepting the little order Cyrillaceæ, of which I have yet seen no member, the first six orders in this paper form the whole of Prof. Lindley's Berberal Alliance, in which the order Vitaceæ occupies the central place lineally. The affinities of this order he thus indicates:—

Araliaceæ.
Berberidaceæ.—VITACEÆ.—Pittosporaceæ.
Rhamnaceæ.

The result of the present observations is remarkable. No plant of the central order examined without finding raphides; while, on the contrary, these were never found at all in any examination of its allies and surrounding orders. Thus Vitaceæ must surely be entitled to the character of a raphis-bearing order. But whether this character will always certainly prove diagnostic, as now seems probable, can only be decided after a complete examination of all the orders in question. So novel is this subject of raphides as natural characters in systematic botany.

Balsaminaceæ, Galiaceæ, Onagraceæ, Phytolaccaceæ, and *Nyctaginaceæ.*—And the same remark applies to these raphis-bearing Exogens, although my observations in the 'Annals' for July

1864, and many since made, have convinced me that, so far as regards the British flora, the raphidian diagnosis is not only quite true, but very natural. Yet, as formerly noticed, this character might more easily escape attention in Galiaceæ than in the other orders.

Finally, the propriety of retaining *Leea* under Vitaceæ has been disputed; and the present observations will tend to support the conclusion of those botanists who, with Adrien de Jussieu and Lindley, persist that this genus ought not to be separated from Vitaceæ.

Edenbridge, July 17, 1865.

[To be continued.]

XIII.—*On the Operculum and its Mantle* (lobus operculigerus, pomatochlamys). By Dr. O. A. L. Mörch.

Adanson* regarded the operculum of univalve shells as answering to the second valve of the bivalves—an opinion maintained by Oken and lately by Dr. Gray† and Prof. Macdonald‡. In this point of view the *lobus operculigerus* (Lovén), or "the opercular mantle," would correspond with one moiety of the mantle of bivalves.

Prof. Lovén regards the bivalve shell as produced by a cloven or bipartite mantle, and the operculum as homologous with the byssus.

Prof. Keferstein§ supports Lovén's opinion, considering the slit in *Emarginula* and *Tenagodus* as a trace of division. The porous slit of *Haliotis*, *Tenagodus*, &c., corresponds with the notch or channel in canaliferous shells (*Entostomata*, Blv.). There is, however, a more important trace of division in many univalves—for instance, the dentated furrow in *Monoceros*, *Pseudoliva*, *Ancillaria*, and some species of *Murex* (*Cerastes*), but chiefly in *Carinaria*. In this last genus the keel is formed by the two sides of the shell, which are pressed against each other in such manner that a piece of paper can be introduced into the middle of the keel as far as the fœtal shell. In *Onustus* (Humphr.) the two sides are cemented together, but the union can be clearly seen. *Akera bullata* shows something similar in

* Hist. Naturelle du Sénégal.

† J. E. Gray "On the Operculum of Gasteropodous Mollusca, and an attempt to prove that it is homologous or identical with the second valve of Conchifera" (Annals and Mag. of Nat. Hist. ser. 2. v. p. 476; and Phil. Trans. 1833).

‡ "On the Homologies of the so-called univalve shell and its Operculum" (Proc. Linn. Soc. v. 1860).

§ Bronn u. Keferstein, Die Klassen u. Ordnungen des Thierreichs.